

XLII.—*Observations on a new Group, Genus and Subgenus, of Freshwater Confervæ, with descriptions of Species mostly new.* By ARTHUR HILL HASSALL, Esq., M.R.C.S.L., Corresponding Member of the Dublin Natural History Society.

[Continued from p. 47.]

VESICULASPERMÆ.

CHAR. Filaments simple, slightly tapering, usually attached, not conjugating, in their young condition cylindrical, articulated; extremities lanceolate; spores usually either oval or spherical, each contained in a separate enlarged cell not unfrequently of the same form as the spore.

My first impression with respect to the species contained in this group was, that it would be sufficient to regard them as constituting a new genus; subsequent reflection and examination have however convinced me that they should hold a higher than a generic station, and that it would be more in accordance with strict propriety to consider them as forming a separate group.

In addition to the distinctive characters indicated in the definition given above, viz. the tapering of the filaments, and the production of spores without union of the filaments, which spores are usually contained in inflated cells, the *Vesiculaspermæ* are distinguished by other, though somewhat less obvious not less important characteristics. The filaments are of a firmer texture than other freshwater *Confervæ*, they possess comparatively but little flexibility, are not mucous, and consequently do not exhibit that glossy appearance presented by so many *Confervæ* when removed from the water, and which they retain when dried upon paper, in all which particulars they stand in marked opposition to that numerous and important division of the freshwater *Confervæ*, the *Conjugatæ* of Vaucher, which have been recently denominated by M. Decaisne, *Synsporées*; in all the species of which division the filaments are flexuous, mucous and shining in the highest degree; in these too the filaments never taper, but are always exactly and equally cylindrical, and the spores, with the four exceptions alluded to in the observations already published on the genera *Zygnema* and *Mougeotia*, are invariably formed by the admixture and union of the contents of two cells of different filaments. Moreover the joints differ in the two groups: in the *Vesiculaspermæ* they are strongly marked, and when dried become contracted and dark-coloured; while in the *Synspores* they are faintly indicated, and in dried specimens are often with difficulty discoverable.

On a careful examination, therefore, of the many points of difference here enumerated between the *Confervæ* which I denominate *Vesiculaspermæ* and the *Conjugatæ*, there are but few, I think, who would be inclined to question the propriety of retaining them in separate groups. The differences are too great to admit of their holding merely a generic rank. The naturalness of the genera *Zygnema*, *Mougeotia* and *Tyndaridea* is now generally admitted, although these pass through certain species one into the other, as already pointed out in a previous paper, and are all allied by family resemblances, such as the extreme mucosity and conjugation of the filaments; but how wide is the interval between any of these and the *Confervæ* composing the group of *Vesiculasperms*!

There remains now but one genus of freshwater *Confervæ*, amongst those with simple unbranched filaments, with which to compare the *Vesiculaspermæ*, and that is the genus *Sphæroplea*. We have here the delicate structure and highly mucous condition of the filaments so obvious in the *Conjugatæ*; but we have likewise the tapering of the filaments equally characteristic of the *Vesiculaspermæ*, and also the formation of spores without union of the filaments. The genus *Sphæroplea* then, of which I shall speak more fully in a future paper, holds in my opinion a station intermediate between the groups *Vesiculaspermæ* and *Synspora*.

The spores in the different species of the group *Vesiculaspermæ* I conceive to be produced in the same manner as in the true species of *Zygnema* referred to in the preceding paper as producing spores without union of the filaments, that is, by the intermingling of the contents of two contiguous cells *in the same filament*, the one containing in all probability fertilizing, the other fertilizable material; this commingling being generally and perhaps always accompanied by the inflation of the receiving cell, the primary form of which is invariably more or less ovate, and the giving cell being constantly placed in communication with the narrow end of the ovate inflated cell.

When a number of inflated cells occur in the same filament, it is a rule that the larger ends of these cells should always point in the same direction. [This union of the contents of two separate cells does not generally take place in so far as I have yet been able to observe in the branched species, although I have ascertained beyond doubt that it does so in one instance, viz. in *Bulbochæte setigera*, the union being followed, as in the other cases, by the inflation of the receiving cell and the formation of a sporaceous mass, whether a true spore or not I am unable to say. Through the genus *Bulbochæte*,

therefore, there is a natural transition from the simple articulated Confervæ to the branched articulated species, as will be hereafter more fully shown. The affinities of this genus have not hitherto been at all understood. M. Decaisne has likewise observed the passage of the contents of one cell to those of a neighbouring cell in *Bulbochæte setigera*, but does not draw the inference from it which I have done.]

The facts in favour of this view of the reproduction of the group are the same as those mentioned in reference to the *Zygnemata* already alluded to, viz. the non-union of the filaments, and the disposition of spores and empty cells, the spores in most of the species of the genus being solitary and lodged in the inflated cells. In some species however inflated cells, amounting to five or six in number, sometimes occur in juxtaposition, and this would appear at first sight opposed to the view adopted; and did each inflated cell contain a perfect spore, this one fact would be altogether irreconcilable with it; but I am of opinion that many do not, which opinion is supported by the circumstance, that in a variety or condition of *Zygnema porticale* which I have recently met with, the filaments of which do not conjugate but still produce seeds, many of the *inflated* cells do not contain spores, as may be plainly seen, owing to the transparency of the filaments.

It is at once apparent that the mode of reproduction just indicated does not differ essentially from that first made known by Vaucher with reference to the *Conjugatæ*, and especially in respect to those most interesting species which I have described as producing true spores without union of the filaments, nor from that of the *Sphæropleæ*. In all these it is virtually the same, and to these groups I believe all the known species of true articulated freshwater Confervæ with simple filaments may be referred, excepting only *Conferva mucosa* and *C. punctata*. They are all perpetuated by means of true spores, these spores being formed in all cases alike, by the union and intermingling of the contents of two distinct cells placed either in the same or different filaments.

This opinion, which, being founded on careful and long-continued observation, I trust will stand the test of innovating time, by which the value of all things must finally be proved, is now for the first time promulgated. It was, of course, known that the spores of the *Conjugatæ* were produced in this way, but it has not, so far as I can learn, been even hinted that the same phænomenon was applicable to all freshwater Confervæ with simple filaments, exclusive of the two species mentioned above.

The discovery of this *identity* in the mode of reproduction

of the classes of Confervæ referred to leads necessarily to some general, and it appears to me not unimportant reflections.

Thus, first, it furnishes evidence amounting to demonstration of the intimate and general connexion which subsists between the greater number of the articulated Confervæ with simple filaments; and second, it throws much light upon the often-canvassed and much-disputed subject of the animality of the conjugating genera. It proves, since in reality a conjugation is necessary to the formation of every true spore, that all the Confervæ stand upon the same footing as regards their animal nature, and that if those species which exhibit the curious phænomena of conjugation are really animal, so are all the other Confervæ mentioned; that if these should ever at any subsequent period be removed from the vegetable kingdom to the animal, so ought as a *sequitur* all the other Confervæ alluded to, the *Vesiculariæ* and the *Sphæropleæ*.

But it appears to me that the facts thus disclosed, so far from adding weight to the arguments of those who would regard the *Conjugatæ* as animal productions, rightly interpreted, tend merely to prove the existence of sexes in the Confervæ, as have been proved by Vaucher to exist in the genus *Vaucheria*, a class of productions nearly related to the Confervæ; and that thus an analogy is established between the lower Confervæ and the higher phanerogamic plants, between which and some of the lower animal tribes a further analogy may be traced.

For my own part I trouble myself but little with the disputes about the boundaries of the two great divisions of the organized world, which forcibly remind me of the search carried on by ancient philosophers for days and years after the much-desired but imaginary and poetical philosopher's stone endowed with such all-pervading influence, or the equally fruitless inquiry after perpetual motion, or any of the other wild chimeras to which the minds of men have from time to time been given. It is my belief that no such rigid boundary exists, for in living nature there are no abrupt unsightly chasms; all is uniformity, order, design and transition.

I would now mention one fact which would appear to show that in the composition of the Confervæ there is something of the animal. When a number of Confervæ have been crowded together in a bottle for two or three days, they emit on their removal what appears to my power of smell to be a strongly animal and offensive odour. A similar offensive smell is emitted by some marine sponges in a state of decay, and as I have more than once noticed, by the freshwater sponge.

That the elliptical, spheroidal or ovate bodies here denominated spores are really the organisms by which the species is perpetuated, one filament proceeding from each, there cannot in my estimation be the shadow of a doubt. They resemble those of the *Conjugatæ* in size, colour and organization, each spore being invested with one, and according to Meyen two or three distinct envelopes; and the germination of these has been witnessed in more than one species by Vaucher, whose veracity and acuteness of observation cannot be doubted for a moment.

In the statement advanced by the younger Agardh, of the disintegration of the usually elliptical or spherical bodies regarded as spores by Vaucher into Zoosperms, and the perpetuation of the species by means of these, I must confess my utter want of faith, both as regards the *Conjugatæ* as well as all other freshwater Confervæ with simple unbranched filaments, appearing to me, as it does, opposed alike to strongly supported facts and to reason, independent of observation. M. Agardh thus states his views respecting the reproduction of a *Conjugata* (the species is not indicated), which he applies generally, not merely to the *Conjugatæ* but to all other Confervæ; and this not from an extended examination of many species, but from an investigation of three only, *Conferva ærea*, *C. zonata*, and *C. crispata*.

“ During the conjunction of a *Conjugata* one of the filaments is always giving, the other always receiving. The spires of the giving filament first become confused, and it is not until after the entrance of the matter of that filament that they become irregular in the other, and then the two masses become confounded together to form the elliptical or spheroidal bodies. The globules of which the spires are composed do not clear themselves the one from the other during the slow emanation of the matter from the giving filament, and no trace of other motion is observed amongst them. On the contrary, it is in the elliptical body constituted by the mingled contents of two joints that I believe to have recognized a phenomenon of locomotion analogous to that described previously in reference to *Conferva ærea*. After many fruitless searches, made for the purpose of seeing the elliptical body develop itself into a new filament, as Vaucher has described, I clearly saw them, on the contrary, dissolve into numerous sporules endowed with a very rapid motion. Apart from the phenomenon of union of the filaments which distinguishes the *Conjugatæ* from all other Algæ, the only peculiarity in their propagation is, that the elliptical bodies from which the sporules

proceed remain often many months without any change in them, while *they dissolve IMMEDIATELY in the true Confervæ.*"

I can affirm, without fear of error, that the statement contained in the last paragraph, so far as any species of Freshwater Confervæ with simple filaments is concerned, is wholly destitute of foundation. The elliptical bodies, which I regard as the true spores, remain in all the species of the group *Vesiculaspermæ* as long in a quiescent state as they do in the *Conjugatæ*; and what good reason, may I ask, could be assigned why they should not, seeing that they are organized alike in both?

M. Agardh suggests the questions, what may be the purpose served in the œconomy of the plant by this motion of zoospores? and how is it carried on? Preparatory to requiring the solution of these questions, I should wish to know the exact manner in which the investing membranes of the spores are disposed of, prior to the escape of the numerous zoospores which each of the elliptical or spheroidal bodies are said by the younger Agardh to furnish, by their disintegration.

In a recent memoir on the classification of the Algæ, published in the 'Annales des Sciences Naturelles' for May 1842, M. J. Decaisne, who differs in many points from Agardh, relates an additional fact, which stands opposed to Agardh's observations, on the separation of the elliptical or spheroidal bodies of the *Conjugatæ* into numerous zoospores. "On pressing out," says M. Decaisne, "the contents of one of these when in a mature condition, and examining them, no trace of any bodies can be detected from which it might be supposed that the zoospores proceeded, the entire contents consisting of globules of an oleaginous appearance, and of air, of different volumes, mixed up with a jelly-like turbid fluid." Upon the subject of the motion of the zoospores, M. Decaisne thus expresses himself:—

"I must declare that I have never been so happy as to witness in the freshwater Confervæ either the escape of the corpuscles by the displacement of their fibres, or the production, on the surface of the same plants, of a papilla perforated by means of the reiterated shock of the reproductive bodies. The membrane of the Confervæ, like that of the Algæ in general, has always appeared to me smooth, and destitute, even to a very high power, of all filamentous organization before its disorganization.

"My opinion, therefore, differs from that of Agardh on the subject of the zoospores properly so called. These corpuscles,

when they present a small transparent prolongation, either straight or slightly curved, do not move it at all; but it happens that, following the side by which they present themselves to the eyes of the observer, this prolongation is visible or it is not. It is necessary, in order to perceive it, that the corpuscles be in profile; in that position it is easy to assure oneself that the prolongation or beak does not make any movement."

My own observations, so far as the freshwater *Confervæ* with simple unbranched filaments are concerned, accord entirely with those of M. Decaisne; but in another class of *Confervæ*, upon which I hope shortly to prepare some observations, I have without doubt frequently seen the perforated papilla, as well as, I believe, though not satisfactorily, the remarkable motion of the zoospores.

M. Decaisne, in the memoir already alluded to, likewise combats the opinion entertained by Agardh, of the existence of two forms of reproductive bodies in some of the genera composing the class (now fast losing its former importance) of Zoospores, for the one of which the term zoospore is especially reserved; this being the small rostrated body endowed with a lively motion, of which many, according to Agardh and M. Decaisne, may be contained in a single cell of *Confervæ*; and the other the much larger spheroidal or elliptical body, resulting often, as in the *Conjugatæ*, from a union and concentration of the contents of two distinct cells. "If, as it is advanced," observes M. Decaisne, "the zoospores and the spherical globules develop themselves in the same manner by the production of filaments, by their growth or extension, it is evident that they present, at a determinate period of their life, specific characters perfectly distinct, for the tubes proceeding from the spores should have a calibre much more considerable than those furnished by the zoospores. It appears to me, therefore, impossible that the same plant can give birth by its germination to two beings specifically different, if it is admitted in all cases that the length and diameter of the cells present, for each particular species, characters constant at a given period. Moreover, it is necessary to suppose that the filaments proceeding from the zoospores enjoy a power of development much greater than the others, to attain in one day the same diameter. The physiologists who have admitted this double mode of reproduction are in general contented to say that the zoospores develop themselves into filaments like to the parent plant; but this has not been, that I am aware, represented in any of their works; while, on the contrary, we there find described and figured in detail the series of deve-

lopments of the external corpuscles (spores or seminules) resulting from a concentration of the green matter; and for the purpose of establishing the series of developments of zoo-spores and of spores properly so called, they have represented, it appears to me, these bodies of very different sizes. They have amplified the first and diminished the second in such a manner as to present them of nearly the same volume. I think that I am able, in support of my opinion, to refer to the text and the figures of the Mémoires of MM. Agardh and Morren inserted in this work."

"The first of these learned men appears, indeed, to have comprehended the difficulty of explaining the development of two sorts of reproductive bodies, since he admits in certain cases the disintegration of spores into numerous sporules endowed with a very rapid movement, that is to say, into zoo-spores."

To the group *Vesiculaspermæ* are to be referred all the true Confervæ; but before admitting any species as such, it is necessary that it should undergo a rigorous examination, for we find placed among the Confervæ proper many species having no relation whatever with those near to which they are located, but are referable to some other of the genera, belonging to other groups already established. Thus *Conferva alpina*, *C. purpurascens*, *C. zonata*, *C. ericetorum*, *C. mucosa* and *C. punctata*, are placed by Agardh the elder and Harvey amongst the Confervæ properly so called. The first two are nevertheless *Conjugatæ*, belonging to the genus *Mougeotia*; the third a *Sphæroplea*; and the fourth ought, in my estimation, to be referred to the branched species of Confervæ; while *C. mucosa* and *C. punctata* form the types of a distinct genus.

I have been so fortunate as to discover the exact characters presented by some of the species when in a state of reproduction, which have been correctly considered as true Confervæ; and so different is the appearance of these, when in that state, that considerable difficulty is experienced in recognizing them, by the descriptions of their discoverers, for the species, of which they intended to convey accurate definitions. Nevertheless, the characters furnished by species in a state of reproduction are almost the only ones to be depended upon as of specific importance. These species are, *Prolifera composita* of Vaucher, *C. vesicata* of Müller*, and *C. bombycina*

* M. Decaisne appears to have seen the spores in this species, and to have understood the mode of their formation, viz. by the intermingling of the contents of two adjacent cells in the same filament, and hence was induced to place it amongst the Synspores, overlooking the many important points no-

(*C. sordida* of Roth). I also refer unhesitatingly to the *Vesiculaspermæ* the following species, with the reproductive characters of which, in detail, I am less fully acquainted, but still sufficiently so to enable me to affirm, without doubt or misgiving, that their proper station is with the group of *Confervæ* which we have been considering; *Conferva fontinalis*, *C. Candollii*, *C. Borissii*, and *C. tumidula* of 'English Botany,' all of which have been erroneously regarded by Harvey as varieties of *Conferva vesicata*. *Conferva tumidula* was first introduced into 'English Botany' under the name of *Conferva inflata*, and with the idea of its being the *Conjugata inflata* of Vaucher; subsequently, on the representation of Mr. Borrer, so well known for the great additions made by him to this and other departments of native botany, the name was altered to *tumidula*, but the species was still supposed to be a member of Vaucher's genus *Conjugata*; which, judging from the figure, I should say that it most certainly is not, and under this impression Sir J. E. Smith has appended to his description some remarks on the *Conjugatæ* in general, which, as it now appears, are somewhat misplaced.

[To be continued.]

XLIII.—*Observations on the Rodentia.* By G. R. WATERHOUSE, Esq., Curator to the Zoological Society of London.

[Continued from p. 203.]

[With a Plate.]

IT is well known to naturalists that there exists in South America many large groups of animals which are peculiar to that continent or are but feebly represented elsewhere. The New World monkeys all form a large section (*Platyrrhini*), of which there are no representatives in the Old. The *Edentata* may almost be called a New World order of mammals. Speaking of two great divisions of the Iguana tribe of reptiles, or "*Sauriens Eunotes*," of MM. Duméril and Bibron, these authors observe, "les Pleurodontes semblent, pour ainsi dire, appartenir exclusivement au nouveau monde, ou aux Amériques [the authors allude almost entirely to the tropical portions], à l'exception du genre *Brachylople*. D'un autre côté,

ticed in this paper, in which it, as well as all the true *Confervæ*, differ from the conjugating *Confervæ*.

In admitting the existence of spores in this one species of *Conferva*, M. Decaisne must now discard the notion of zoospores from his mind, in reference to the reproduction of all the true freshwater *Confervæ* with simple unbranched filaments, the same phenomena occurring in them which he has noticed in *Conferva vesicata* (*Vesiculifera Mülleria*).